

THE GREAT SMOKY MOUNTAINS
WITH PRELIMINARY NOTES ON THE SALAMANDERS
OF MT. LECONTE AND LECONTE CREEK

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I. INTRODUCTION.

During the year 1928-29, the writer submitted a thesis entitled, "An Ecological Study of the Distribution of Animals on Mt. LeConte, and along LeConte Creek," to the Graduate Committee of the University of Tennessee in partial fulfillment of the requirements for the degree of Master of Arts. The thesis was the result of a study of the Great Smoky Mountains and a preliminary ecological survey of the distribution of its fauna, based on observations and collections. The collection is composed of a large number of snails, crayfishes, spiders, insects, salamanders, toads, lizards, snakes, and others. From this collection the identification of the salamanders has been made, and it was thought advisable to publish a brief description of the Smoky Mountains, together with the notes on salamanders.

II. ACKNOWLEDGMENTS.

The writer wishes to express his gratitude to Dr. E. B. Powers, Department of Zoology, University of Tennessee, who has offered many helpful suggestions throughout the year; and to Dr. G. K. Noble, and associates, Department of Herpetology, American Museum of Natural History, New York City, who identified the various specimens of the collection.

Thanks are due to Mr. James E. Thompson, Knoxville, Tennessee, who furnished photographs illustrating the various habitats.

Grateful acknowledgments are due the New York Zoological Society for the publication; and Dr. Horace W. Stunkard, New York University, for assisting in the preparation of the manuscript.

III. THE GREAT SMOKY MOUNTAINS.

Location.

The term Smoky Mountains is somewhat synonymous with the Unaka Mountains which continue westward along the entire border line between Tennessee and North Carolina to Georgia. But that part of this range bounded by the Pigeon River which breaks through from North Carolina on the northwest, and the

Little Tennessee River on the southwest can be called the Great Smoky Mountains proper.

Physiography.

The entire length of the Smoky Mountains, which is approximately sixty miles, for the most part, forms the water divide between Tennessee and North Carolina. The width of the mountains varies extensively, but is approximately thirty miles. The acreage has been estimated to be more than 450,000. The altitude varies from 1,500 to over 6,600 feet above sea level, forming the steepest vegetative slopes in America. The temperature varies from 100 degrees F. at the base in the hot summer days to 20 degrees F. below zero on the summit in the coldest winter nights.

Geology.

Geologically the Great Smoky Mountains are the oldest mountains in America. They are composed of limestones, shales, slates, sandstones, quartzites, conglomerates, gneisses, schists, and perhaps granite. They range from the Mississippian to the Archean period, and most of them are Pre-Cambrian. They are apparently non-fossiliferous. So far as is known there are no mineral or ore deposits of economic importance found in this locality.

Peaks.

For more than twenty-eight miles, the crest of the mountain rises more than a mile above sea level. Among the most important peaks are Mount Cuyot, Clingman's Dome, Siler's Bald, Thunderhead, Laurel Top, Mount Collins, Briar Knob, and many others. But the most outstanding is Mount LeConte.

Streams.

The region as a whole is mesophytic. Scarcely does a day pass that there is not a drenching rainfall in some section. Hence there are numerous streams throughout the whole mountain region. Among the largest, as known by the natives, are Little Tennessee, Little River, Little Pigeon, and Pigeon, with their tributaries.

Coves.

There are numbers of rich coves at the base of the mountains that are inhabited by Anglo-Saxon stock. Among these are Jones Cove, Emerts Cove, Wears Cove (Valley), Tuckaleechee Cove, Cades Cove, Cosby Cove, and many others.

Trees.

The forest as a whole may be classed as deciduous, although coniferous trees dominate the summits of the higher peaks and may be found throughout the slopes. The hard woods include many species, chief of which are poplar, basswood, white oak, black oak, chestnut, sugar maple, buckeye, birch, and beech. The soft woods consist of white pine, shortleaf yellow pine, hemlock, spruce, balsam, Virginia scrub pine, and pitch pine.

Shrubs and Plants.

Among the trees along the slopes are found mountain laurel (ivy), rhododendron, sand myrtle, dogwood, redbud, vacinium, dog hobble, flame azalea, trilliums, orchids, trailing arbutus, Virginia bluebells, sorrel, violets of many species, and over two hundred varieties of flowering shrubs and plants varying from semi-tropical to those of the Canadian region.

Ferns, Liverworts, and Mosses.

There is a great number of ferns, liverworts, and mosses throughout the entire section. In many places the ground and ledges are completely covered, especially at the higher altitudes, where large beds of sphagnum and mountain fern-moss form a carpet more than a foot deep.

Animal Life.

To the average person, animal life may appear comparatively scarce. Yet a naturalist may find an abundance of wild life in the various habitats. Among the lower levels, occur animals that are common in East Tennessee. A large variety of snails, spiders, centipeds, including scorpions, are typical. Of the insects most of the orders are represented by one or more species. Spring-tails (*Collembola*) are abundant on the moist ground

everywhere. Grasshoppers, crickets, katy-dids, and cockroaches are abundant on the forest margin and lower slopes. May-flies and stone-flies are found near the water, and the nymphs are abundant in the swift streams. A few dragon-flies may also be found. There is a large number of hemipterous insects found both in the water and on the flora. Of the beetles, ground and wood-boring species are more prominent. Scorpion-flies may be noted in the thick field strata along the trails. In the streams numerous caddice-fly nymphs may be found. Butterflies and hymenopterous insects are found wherever there are flowers at any level.

In many of the streams and brooks there can be found bass, perch, rainbow, and speckled trout. Many other species of fish, common in East Tennessee, may be found in the lower altitudes.

The most abundant of all amphibia are the salamanders. They abound in the streams and moist slopes, and may be collected in any locality. Toads are abundant, while frogs are found in the low altitudes.

Several species of lizards are found along the forest margin. There are also a few land and fresh water turtles.

A few varieties of snakes are found. The two most dreaded are the rattler and copperhead, these being the only two known to possess poisonous fangs. The black snake, blue-racer, fox snake, water snake, garter snake, king snake, and the small ring necked snake are present, but are not often encountered.

The summer-dwelling birds number less than one hundred species. Among the most common, dwelling near the settlements and along the mountain sides, are sparrows, bobwhites, doves, woodpeckers, flickers, goldfinches, towhees, cardinals, indigo buntings, yellow-breasted chats, wood thrushes, brown thrashers, wrens, robins, and various warblers. Those that choose the higher altitudes are the ruffed grouse, wild turkey, yellow-bellied sapsucker, Canada warbler, Wilson thrush, brown creeper, pheasant, golden eagle, northern raven, and the duck hawk. Chimney swifts, chickadees, and the Carolina juncos are most abundant.

Many of the mammals that once roamed the forest have become extinct. Others have become so scarce that weeks are re-

quired to locate them. Among the animals that are left in the Smokies are the Virginia opossum, Virginia deer, wood hare, Carolina wood vole (mouse), woodchuck, eastern chipmunk, red squirrel, raccoon, Carolina weasel, Carolina skunk, American black bear, gray fox, red fox, wild cat, shrew, and bats.

Summary.

The Great Smoky Mountain section of North Carolina and Tennessee is noted for its ruggedness of area, its variation of altitude and temperature, its geological age, its humid atmosphere, its unparalleled variety of trees, flowering shrubs and plants, and its innumerable host of animal life. These have attracted scientists and nature-loving tourists from every part of the United States, and from many parts of the world.

The great demand for the preservation of this virgin forest, has inspired public spirited citizens to purchase the holdings of private lumber companies and soon this section will become "The Great Smoky Mountain National Park".

IV. DESCRIPTION OF LECONTE CREEK

A close observation of the valley has been made and it has been zoned according to the vegetation, which is composed of virgin timber. Each zone was divided into plots, one thousand feet in length.

Chestnut Zone.

The first zone extends approximately one and one-half miles, and includes the first seven plots. It is largely composed of oaks, birches, buckeyes, poplars, and beeches, which attain a very large size. But the dominant tree is the chestnut; this is being destroyed by the chestnut blight and apparently is being replaced by oaks. Numerous shrubs and plants are present. A number of large trees have fallen and are in a decaying state.

The stream in this zone has an average of about 10 percent fall and is for the most part shallow, containing numerous large boulders, some of which are covered with moss and rock ferns. Several deep pools are formed where the water plunges over large rocks. Two or three small islands are formed at the bases of the coves; these contain trees and other vegetation.

BAROMETRIC LEVELINGS OF LECONTE (MILL) CREEK.

THE TABLE SHOWS THE BAROMETRIC PRESSURE IN INCHES AND THE ALTITUDE IN FEET OF LECONTE CREEK, BEGINNING AT THE BRIDGE IN CHEROKEE ORCHARD AND CONTINUING UPWARD TO THE SOURCE, AND FROM THENCE UP THE VALLEY TO THE LOWEST POINT BETWEEN MAIN TOP AND WEST PEAK. EACH PLOT REPRESENTS 1,000 FEET.

PLOT NO.	PRESSURE	ALTITUDE
0	27.2 in.	2800 ft.
1	27.05	2950
2	26.82	3150
3	26.7	3300
4	26.6	3450
5	26.5	3550
6	26.5	3850
7	26.1	3950
8	25.9	4150
9	25.8	4250
10	25.75	4325.6 U.S. BM.
11	25.25	4800
12	25.0	5100
13	24.85	5300
14	24.55	5650
15	24.25	5950
16	23.9	6350
17 (500 FL.)	23.82	6450

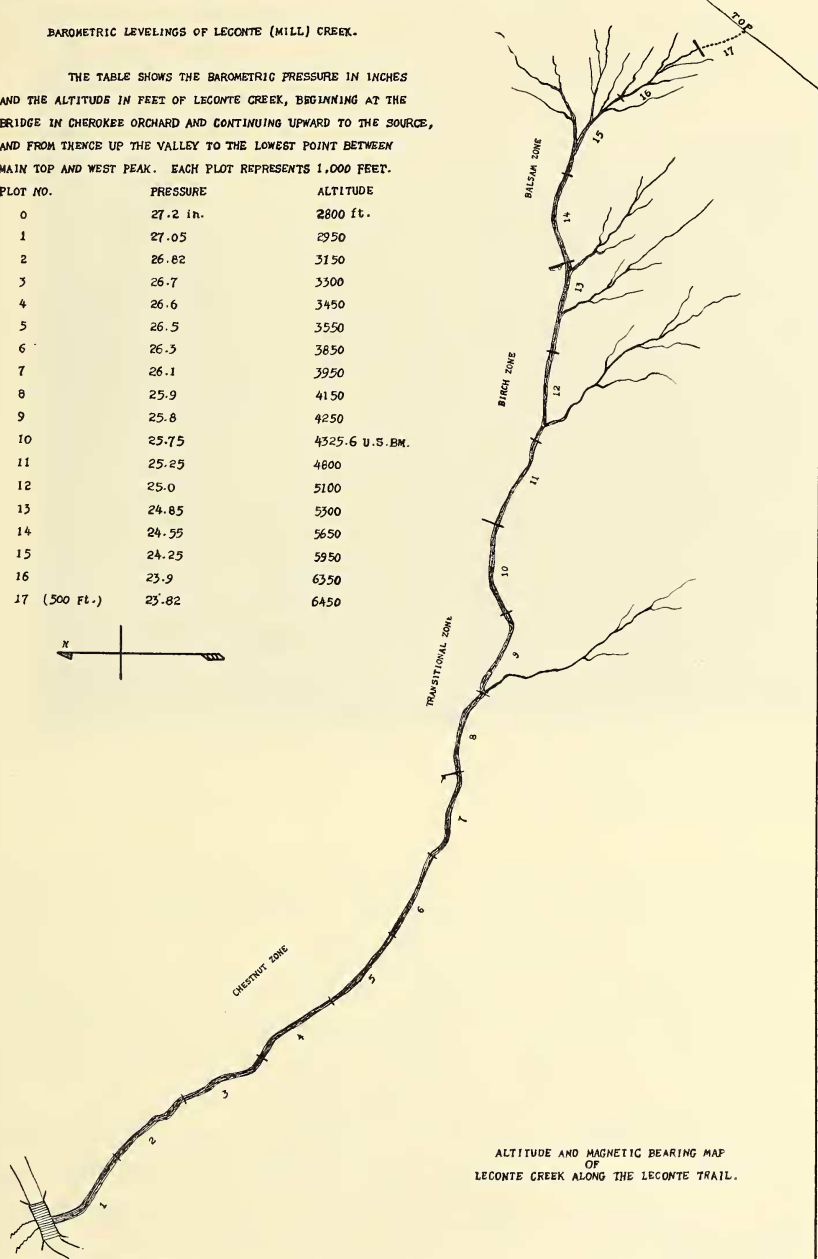
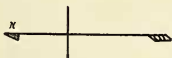


Figure 74.



than 450,000 acres of virgin forest. Mount LeConte rises 6,680 feet above sea one of the steepest vegetative slopes in America.
E. Thompson, Knoxville, Tennessee.

The trees are not as large as those in the previous zone, but are, however, much thicker and taller. The dominant tree is not outstanding and has not been determined.

The stream has an average fall of 10 percent. It contains larger boulders, than the previous zone, and is intercepted by many falls and rapids. A small branch enters from the west about mid-way of the zone. The valley is not as wide in this zone, but the slopes are steeper. *Rhododendron* covers the entire west side of the valley to the water's edge. On the east, large cliffs are prominent, and large rocks prevail throughout the entire zone.

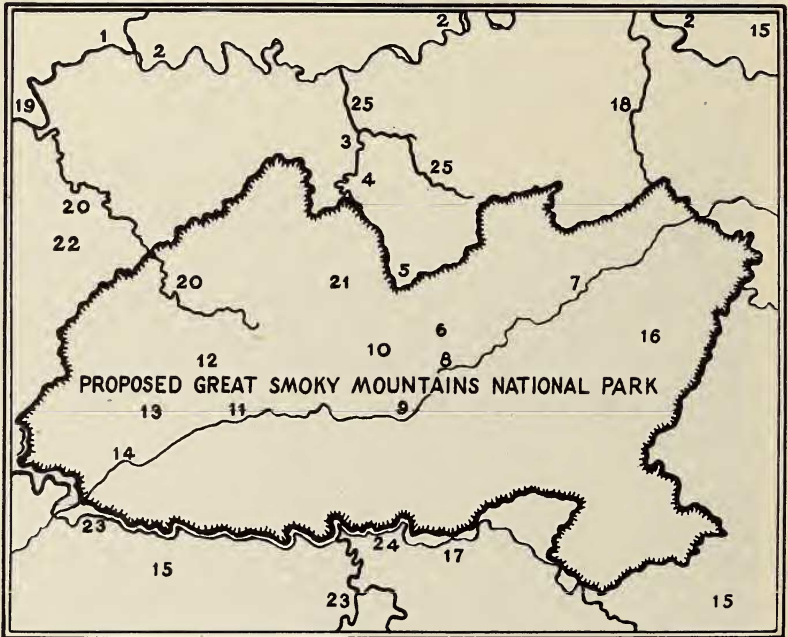


Fig. 73. The proposed Great Smoky Mountains National Park includes more level, and over a mile above its base, forming
Photograph and copyright by James

The slopes of the valley vary somewhat, but in general they are not very steep. An old deserted house and two log barns stand within a few hundred feet of the stream at the edge of the Cherokee Orchard which continues about one-half of the zone. The LeConte trail leads along the left side of the stream the entire length of the Chestnut Zone.

Transitional Zone.

This zone, which extends approximately 3000 feet and includes the next three plots, ends at Rainbow Fall. It consists of hemlock, buckeye, hard maple, red maple, black cherry, white ash, birch, oak, and many small shrubs, plants, mosses and ferns.



OUTLINE MAP OF SMOKY MOUNTAINS NATIONAL PARK

Fig. 75. This outline map of the Great Smoky Mountains National Park area is reproduced from the U. S. Geological Survey Topographic Map and keyed to indicate location of points of interest in and around the park, and more prominent land-marks. The Tennessee-North Carolina boundary line is shown extending across the park, and about equally dividing it between the two states. The total area of the park extends about sixty miles east and west, and about thirty miles north and south at the widest point. The key figures indicate: 1, Knoxville, Tennessee; 2, French Broad River; 3, Sevierville, Tennessee; 4, West Fork Little Pigeon River; 5, Gatlinburg; 6, Mount LeConte (6580 feet); 7, Mount Guyot (6636 feet); 8, Indian Gap; 9, Clingman's Dome (6680 feet); 10, Sugarland Mountain; 11, Thunderhead; 12, Rich Mountain; 13, Cade's Cove; 14, Gregory Bald; 15, Pisgah National Forest; 16, Balsam Mountain; 17, Bryson City, North Carolina; 18, Pigeon River; 19, Tennessee River; 20, Little River; 21, Norton Big Trees; 22, Maryville, Tennessee; 23, Little Tennessee River; 24, Tackasegee River; 25, Little Pigeon River.

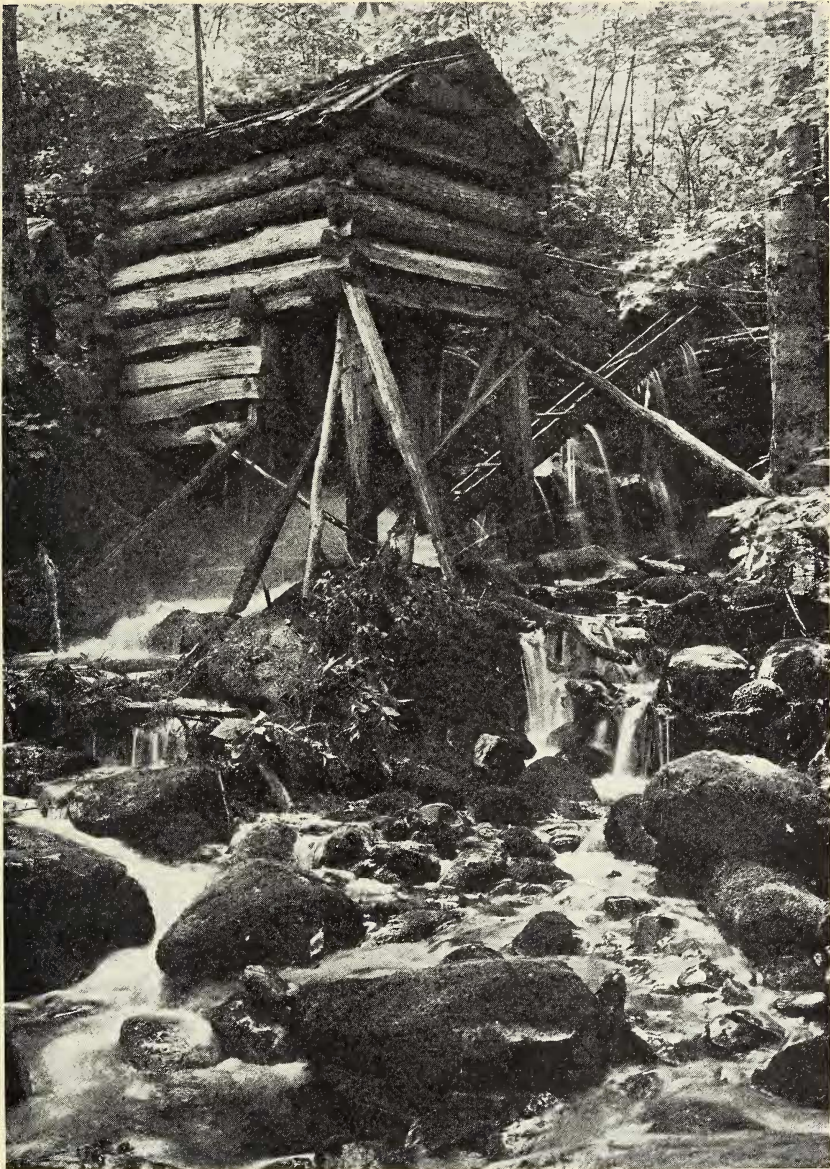


Fig. 76. The old grist-mill, in Cherokee Orchard, is an ideal relic of pioneer days. Numerous large boulders partially covered with moss are prevalent throughout the Chestnut Zone. Photograph and copyright by James E. Thompson.

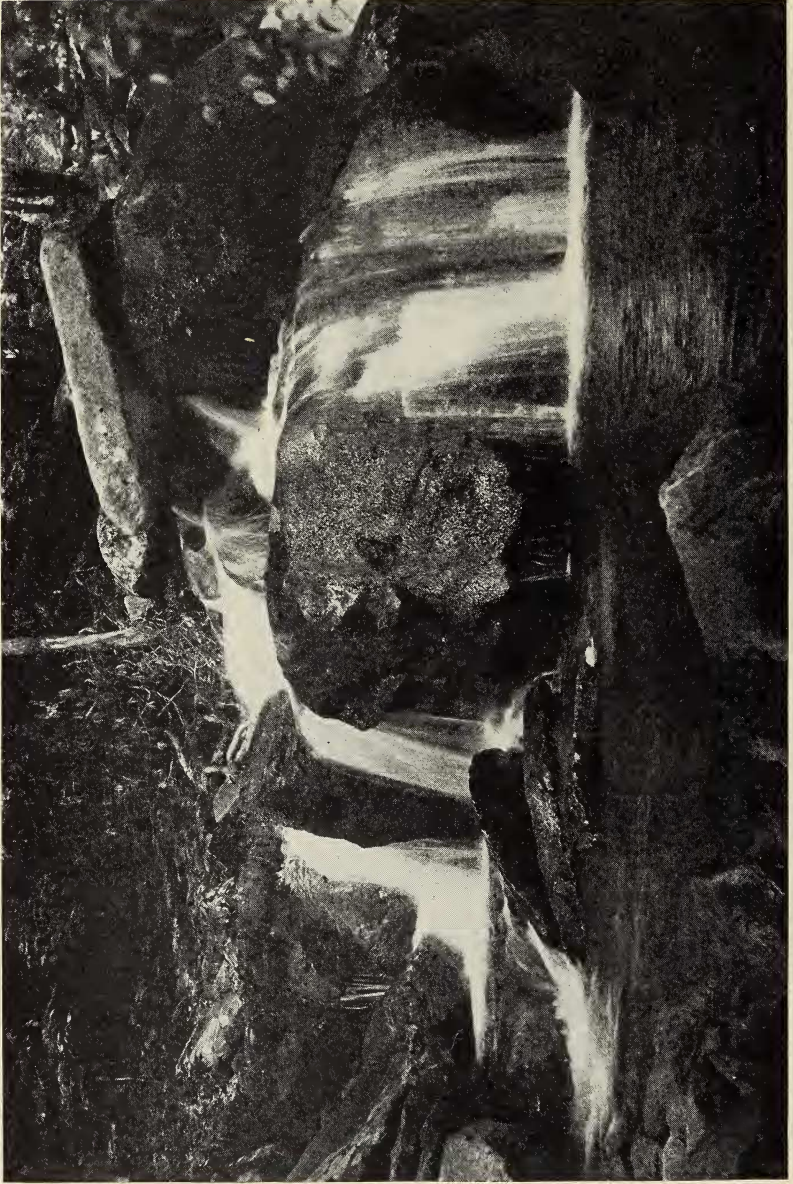


Fig. 77. Water-falls and small rapids intercept the stream forming whirlpools and eddys where salamander larvae abound under decaying leaves near the water's edge. A scene in the Chestnut Zone. Photograph and copyright by James E. Thompson.



Fig. 78. Rainbow Falls marks the end of the Transitional Zone, and is the only natural barrier in the entire stream. The altitude at the top is 4,325.6 U. S. B.M. The water makes a plunge of eighty-five feet. The photograph was taken after a heavy rainfall. Photograph and copyright by James E. Thompson.



Fig. 79. Giant ferns and birch trees cover the side of Gregory Bald. This scene is typical of the Birch Zone of Mt. LeConte. Photograph and copyright by James E. Thompson

The trail leads along the east side of the stream the entire length of the Transitional Zone.

Birch Zone.

This zone includes the next three plots, and is composed of birch, buckeye, balsam, spruce, white maple, viburnum, and rhododendron. The trees are larger and not as thick in the lower altitudes as they are higher up in the zone. In the openings there is a variety of flowering plants. Moss and ferns are prevalent.

At Rainbow Falls the stream is wide and as one ascends it becomes narrower and swifter, having a fall of 32 percent. The falls are larger and the rapids more frequent than in any other zone.

In general the valley becomes somewhat narrow, and the slopes very steep. The large boulders and cliffs are partially covered with moss and ferns. About a third of the way, a small stream flows from the west. Here the valley is somewhat wider. At the upper end of the zone there is a small western cove, from which flows another stream. Here a small delta has been formed upon which are a few large trees.

The trail crosses the creek twice in the Birch Zone.

Balsam Zone.

This zone includes the last three and one-half plots of our area. It is composed of balsam, spruce, red cherry and white ash, which are typical of Canadian forests. Balsam is by far the most abundant. The trees are so thick that the ground is continually shaded. White maple, viburnum, and huckle-berry shrubs are prevalent on the crest. After a short transitional section the ground is completely covered with fern-moss, sorrel, and ferns.

Here we find the stream steepest, having a fall of 34 percent. After a few hundred feet there are very few large boulders and high cliffs. The stream is fed by a large number of seeps a few hundred feet from the crest, which is directly between Main Top and West Peak.

After a few hundred feet the valley widens extensively and forms a long gentle slope.

Near the top the trail leaves the stream and leads directly east one-half mile to LeConte Lodge.

Summary.

According to the United States Biological Survey, Fourth Provisional Zone Map, the forest ranges from the Transition to the Canadian. The summit is covered with fir, typical of this zone. Sphagnum, fern-moss and ierns completely cover the ground. As one descends the mountain the deciduous forest appears, principally birch and buckeye. Replacing these at a lower level are the chestnuts and oaks.

The stream is classed hydropsychyche, containing numerous falls, rapids, large boulders, a few deep pools and shoals.

The entire valley contains virgin forest, flowering shrubs, and plants. The slopes are steep, containing many cliffs practically covered with moss and ferns. Numerous boulders are exposed along the valley for the most part.

The best approach to Mt. LeConte is by way of Cherokee orchard where the last residence is left behind. For more than three miles a trail, too rough and steep for pack horses, follows LeConte Creek to a small lodge on the summit.

V. THE PROBLEM.

So little attention has been given to the fauna of this region from an ecological stand-point that any comprehensive attempt on my part would seem futile. Nevertheless, there is an unusual opportunity to study life, environment and heredity in its natural state undisturbed by the agencies of man.

Mt. LeConte is typical of the whole region and this section was selected for the present survey.

The problem chosen for this report deals only with the salamanders, and is two-fold: First, to determine the number of species found; and second, to determine the distribution of the different species.

VI. TECHNIQUE AND METHODS.

During the winter months numerous trips were made to Mt. LeConte and winter conditions were studied. During this time

plans were formulated for the survey. On May 15, temporary headquarters were made above Rainbow Falls. Through the coöperation of J. Walter White and R. F. McClure the entire stream, beginning at the Cherokee Orchard and continuing upward to the point directly between Main Top and West Peak, was surveyed and plotted. A United States Engineering compass was used to secure the calls. An ordinary chain was used to measure the distance. At the end of each thousand feet the pressure and altitude were recorded. The data were made with an aneroid barometer checked at United States Bench Marks. A metal tag, with the plot number, was tacked to a tree at the end of each plot. So far as was possible all collections were made under uniform weather conditions. The time consumed at each plot was approximately equal. The animals were collected in their natural habitats without the use of trapping, baiting, or any method of congregating them.

A dip net was used for specimens found in the stream. Adult specimens were found near the stream by turning over stones, logs, and moss. The animals from each plot were collected and preserved in separate jars or vials in ten percent formaldehyde. Each container was labelled, giving the plot number and date.

The following table shows the distribution of salamanders collected along LeConte Creek. The figures at the top indicate the plot from which the salamanders were taken.

TABLE I.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
<i>Desmognathus quadra-maculatus.</i>	0	0	2	3	3	3	6	9	13	23	8	4	3	5	3	0	0	85
<i>Desmognathus phoca.</i>	1	0	2	0	1	1	1	1	2	2	0	0	1	0	0	1	0	13
<i>Desmognathus fuscus carolinensis</i>	0	2	1	1	2	1	1	2	2	2	3	5	1	1	2	3	0	29
<i>Plethodon jordani.</i>	0	1	0	0	0	1	2	1	3	1	1	1	2	5	8	13	19	38
<i>Cyrinophilus danielsi.</i>	0	0	0	0	0	0	0	0	1	0	3	0	2	0	0	0	0	6
<i>Eurycea bislineata wilderae.</i>	0	1	1	4	2	5	1	2	3	2	0	1	1	0	0	1	0	24
<i>Desmognathus larvae.</i>	3	9	7	19	30	32	26	20	19	29	2	8	2	3	2	1	0	212
Total.	4	13	13	27	38	43	37	35	43	59	17	19	12	14	15	19	19	407

VII. DISCUSSION.

The Salamanders collected from this locality belong to a single Family, the Plethodontidae.

Desmognathus quadra-maculata (Holbrook).

These specimens are semi-aquatic, living in or near the stream, and when disturbed, plunge into the water and are difficult to collect once they hide under large rocks.

The first specimens were collected in Plot No. 3, at an altitude of 3150 feet. There is a steady increase in number of specimens encountered, to the end of the Transitional Zone. Rainbow Falls marks the end of the Transitional Zone, and is the only natural barrier in the entire stream. The altitude at the top is 4325.6 U.S. B.M. Here the water makes a plunge of 85 feet, and while the falls itself is only a few feet wide, the cliff is more than 300 feet wide. As many as 52 specimens have been counted lying upon the moist rocks by the observer at one time. Only a few specimens were observed above the Falls, and not any were found above an altitude of 6000 feet.

In the summer of 1930, 33 specimens were collected in the Transitional Zone.

Desmognathus phoca (Matthes).

This species seemed to be very evenly distributed along LeConte Creek. They are found most frequently in the water, but may be encountered some distance from the stream under the thick moss or bark of decaying logs.

Desmognathus fuscus carolinensis (Dunn).

This species is more or less terrestrial, and occupies the slopes rather than the streams. Occasionally one may be taken from or near the stream. They, like *Desmognathus phoca*, seem to be very evenly distributed along LeConte Creek.

Plethodon jordani Blatchley.

This species is found only in the Great Smoky Mountains. It occupies the tops of many of the highest peaks. It is terrestrial, and may be found under decaying logs and moss. The first was collected at an altitude of 3000 feet, but they are more abund-

ant above 5000 feet. Only a few were collected, but large numbers were observed under the moss from decaying logs. It is interesting to note the color variation of the red cheeks.

Gyrinophilus danielsi (Blatchley).

This species is not very frequently encountered. One larva was taken from the Transitional Zone, and five adults from the Birch Zone. The adult is very sluggish, and the five specimens were taken at night near the stream, at an altitude of above 5000 feet.

Eurycea bislineata wilderae Dunn.

This species is the most attractive of the salamanders in the collection. It is very evenly distributed along the stream. They are terrestrial, living under rocks and decaying logs.

Larvae.

A large number of larvae was taken from the water. They abound in the shallow pools under fallen leaves, and are most abundant in the Chestnut Zone.

VIII. SUMMARY.

This paper contains a brief description of the Great Smoky Mountain area, emphasizing its unparalleled variety of flora, and listing a large number of its fauna. A more detailed description of Mt. LeConte and LeConte Creek is given together with photographs illustrating the vegetation of various Zones.

The problem and procedure is clear. The results are based on observations and collections of more than four hundred specimens of salamanders.

1. Six species belonging to four genera, and a single Family, were found in the section studied.

2. The distribution of the salamanders collected are tabulated in Table I. Conclusions based on this Table are as follows:

a. *Desmognathus phoca*, *Desmognathus fuscus carolinensis*, and *Eurycea bislineata wilderae* appear somewhat evenly distributed throughout the area studied.



Find this a haven of rest after a long climb up the mountain side. Fig. 81. **Below:** Dense forest a foot thick. Note the decaying logs where numbers of red-cheeked salamanders may be collected.



Fig. 80. Above: The LeConte Lodge is located on the summit of Mt. LeConte. Hikers
growth of balsam shadow the ground where fern-moss forms a carpet more than
Plethodon jordani



Fig. S2. Tall trees crowd the forest to the water's edge high in the Balsam Zone of the Great Smoky Mountains.
Photograph and copyright by James E. Thompson.

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